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Smith

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(54) **PASSABLE NO-GO DEVICE FOR DOWNHOLE VALVE**

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(51) **Int. Cl.**
E21B 23/00 (2006.01)

(52) **U.S. Cl.** **166/237**; 166/319; 166/238

(58) **Field of Classification Search** 166/237, 166/319, 238, 381, 382, 386
See application file for complete search history.

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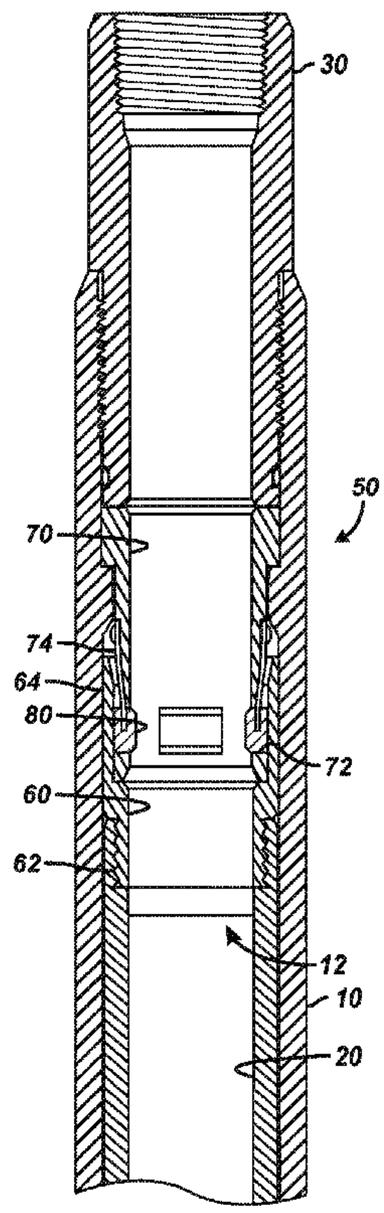
(57) **ABSTRACT**

A downhole valve has a flow tube hydraulically actuated to open and close a flapper. The flow tube moved to a first position closes the flapper to restrict flow through the valve. The flow tube moved to a second position opens the flapper. A passable no-go device disposed in the valve permits or restricts mechanical passage through the valve in response to the position of the flow tube. The apparatus has a support and one or more dogs supported in windows of the support and biased by springs. The flow tube in the first position pushes the dogs to an extended position that restricts mechanical passage through valve so that a tool cannot be passed through the valve while the flapper is closed. When the flow tube is in the second position, however, the dogs retract so the tool can be passed through the valve while the flapper is open.

20 Claims, 4 Drawing Sheets



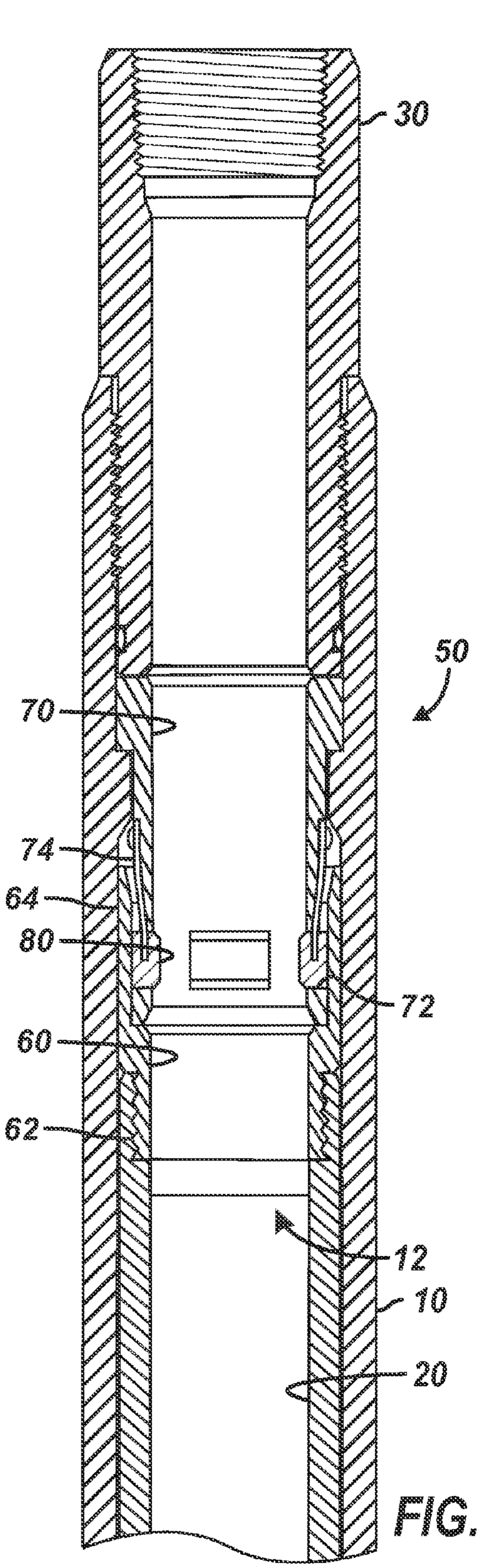


FIG. 1A

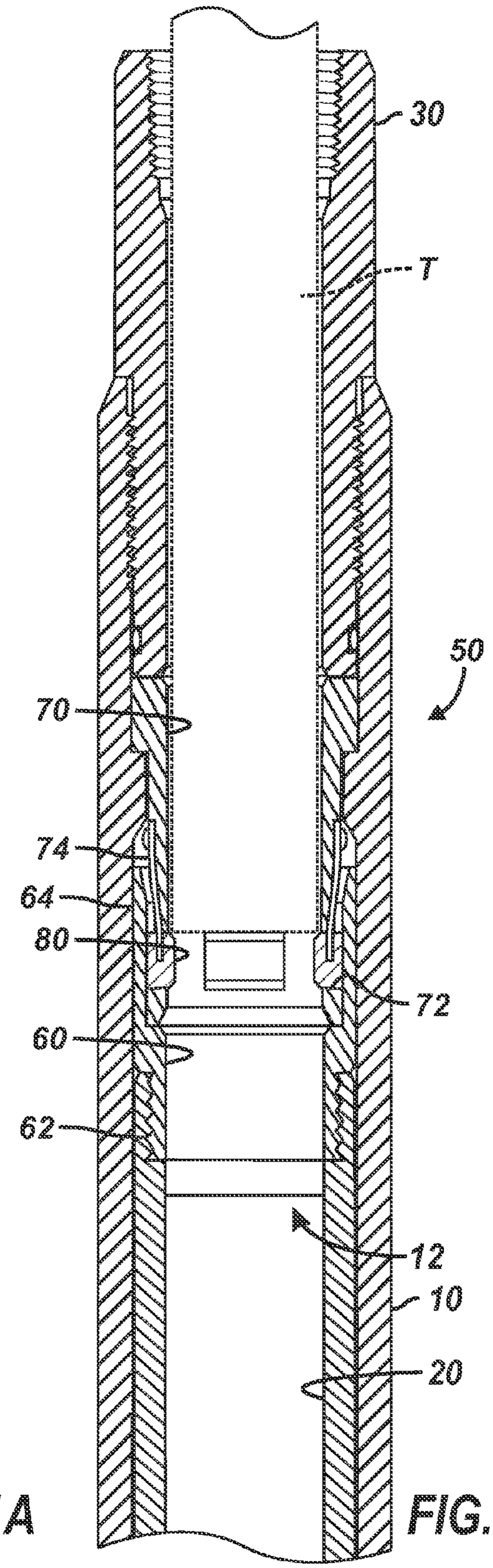


FIG. 1B

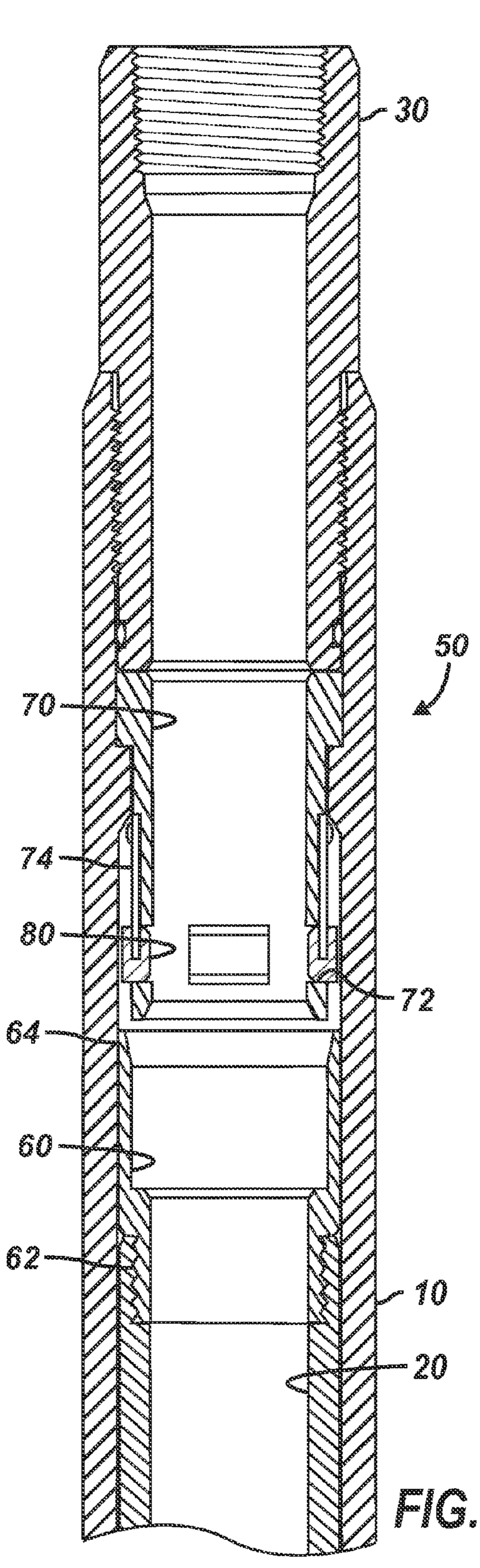


FIG. 2A

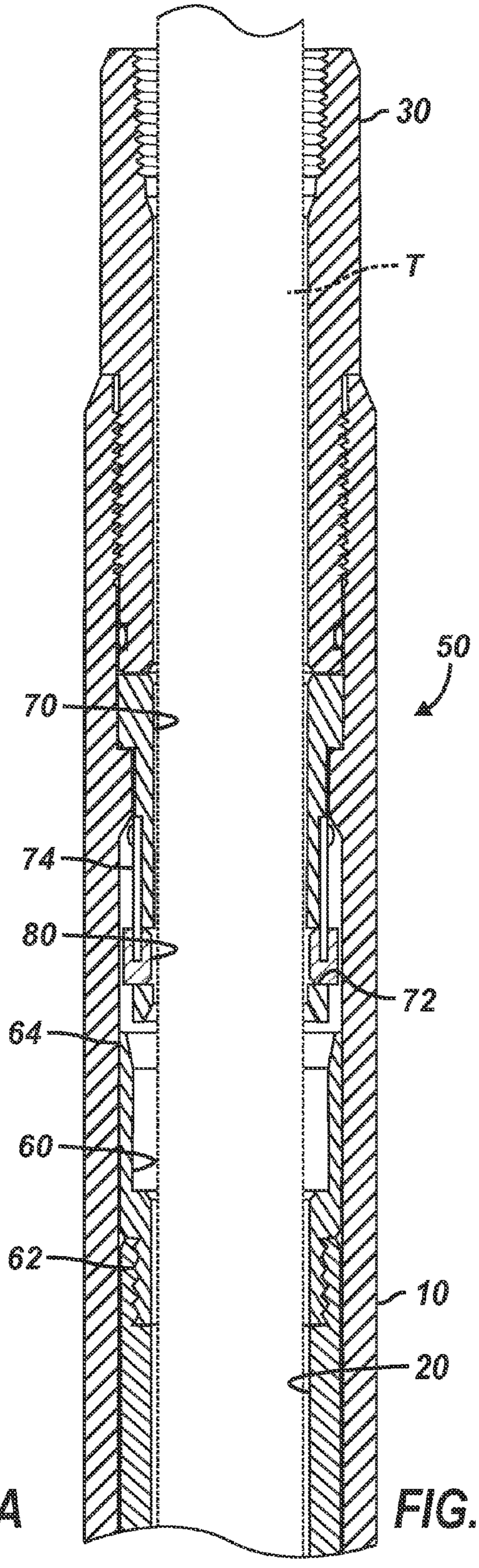


FIG. 2B

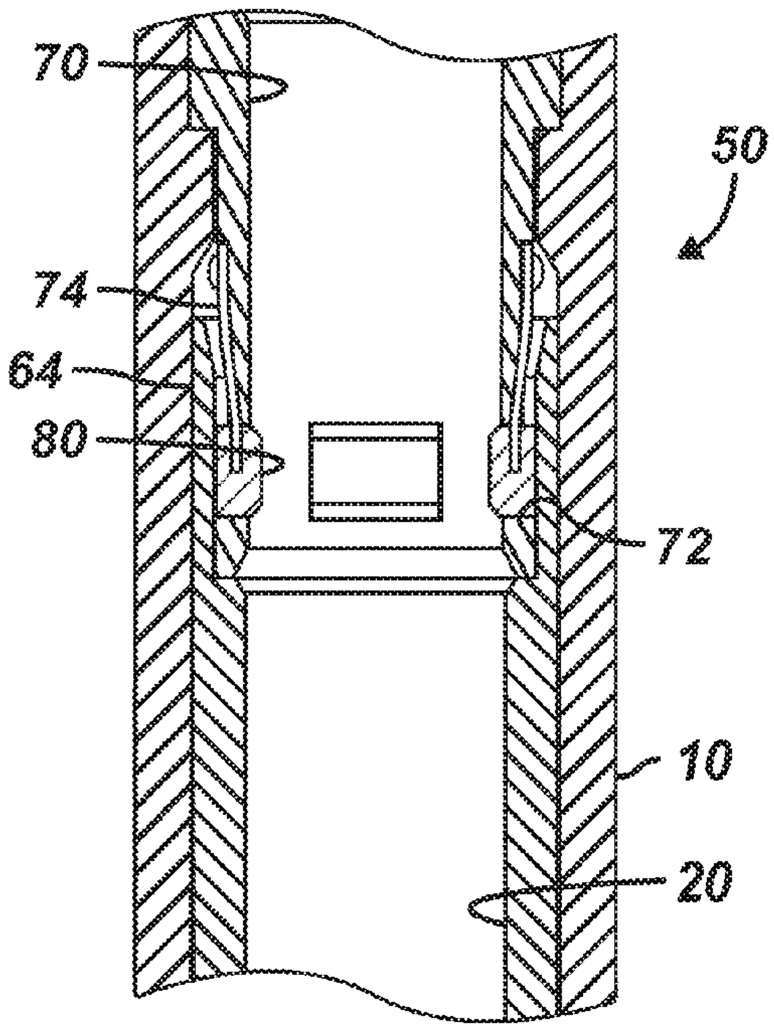


FIG. 3A

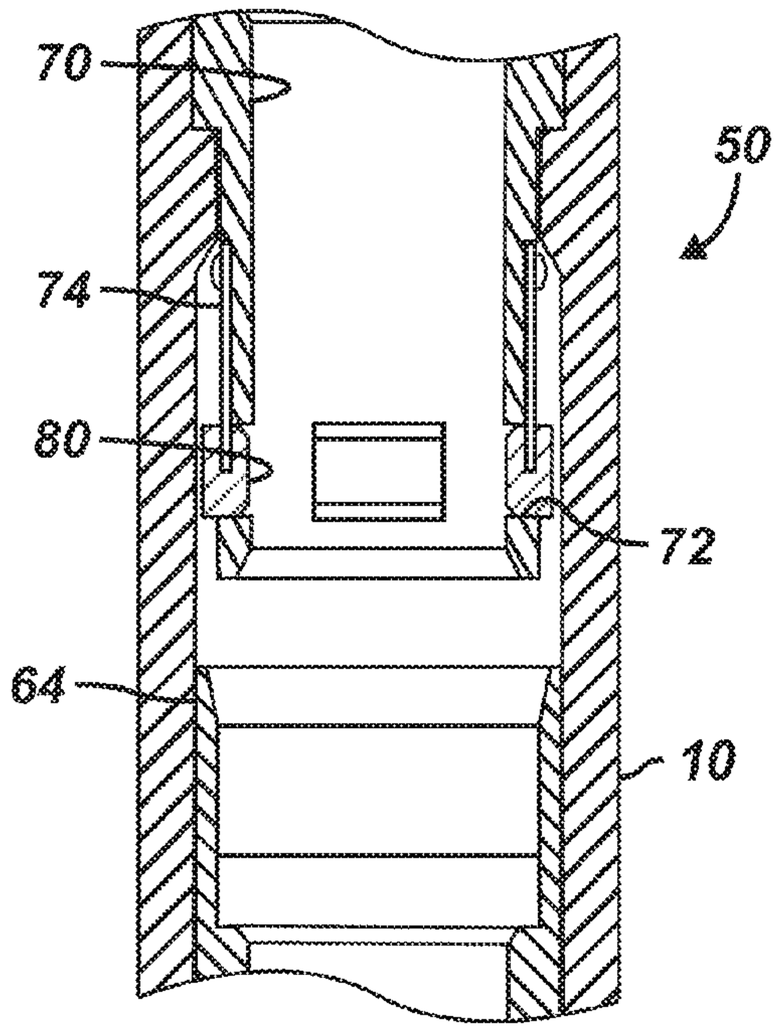


FIG. 3B

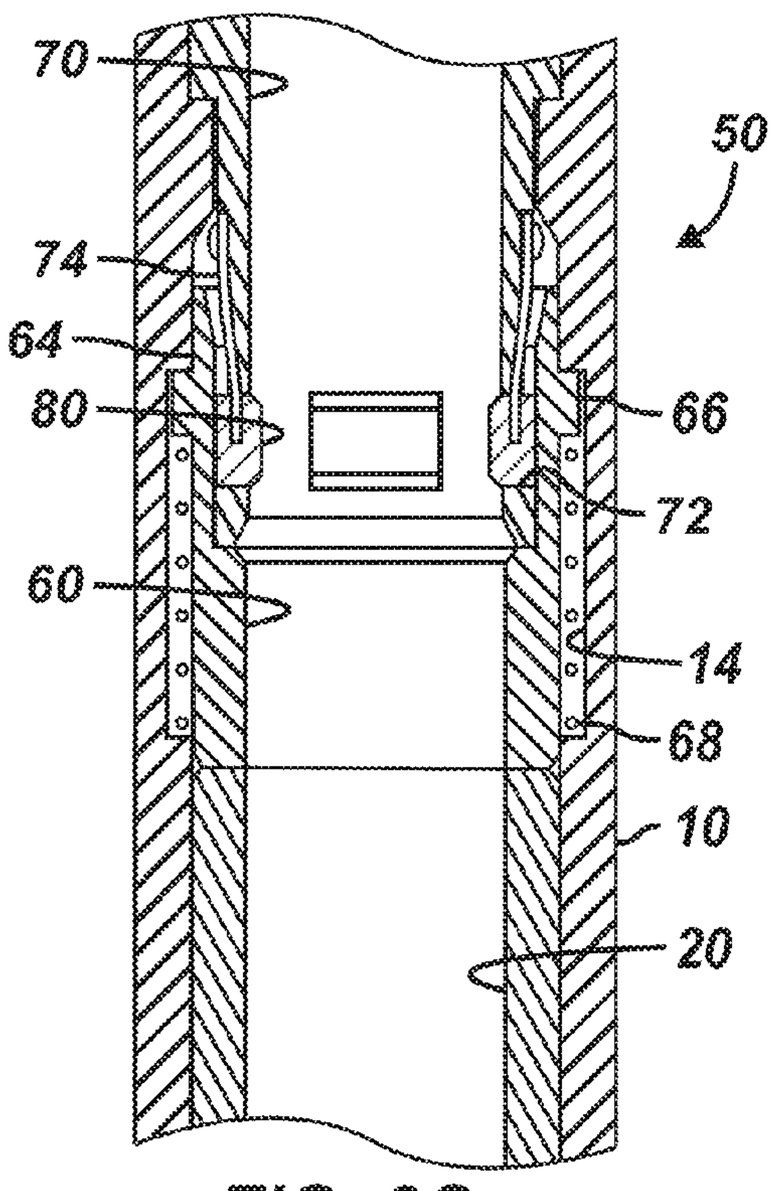


FIG. 3C

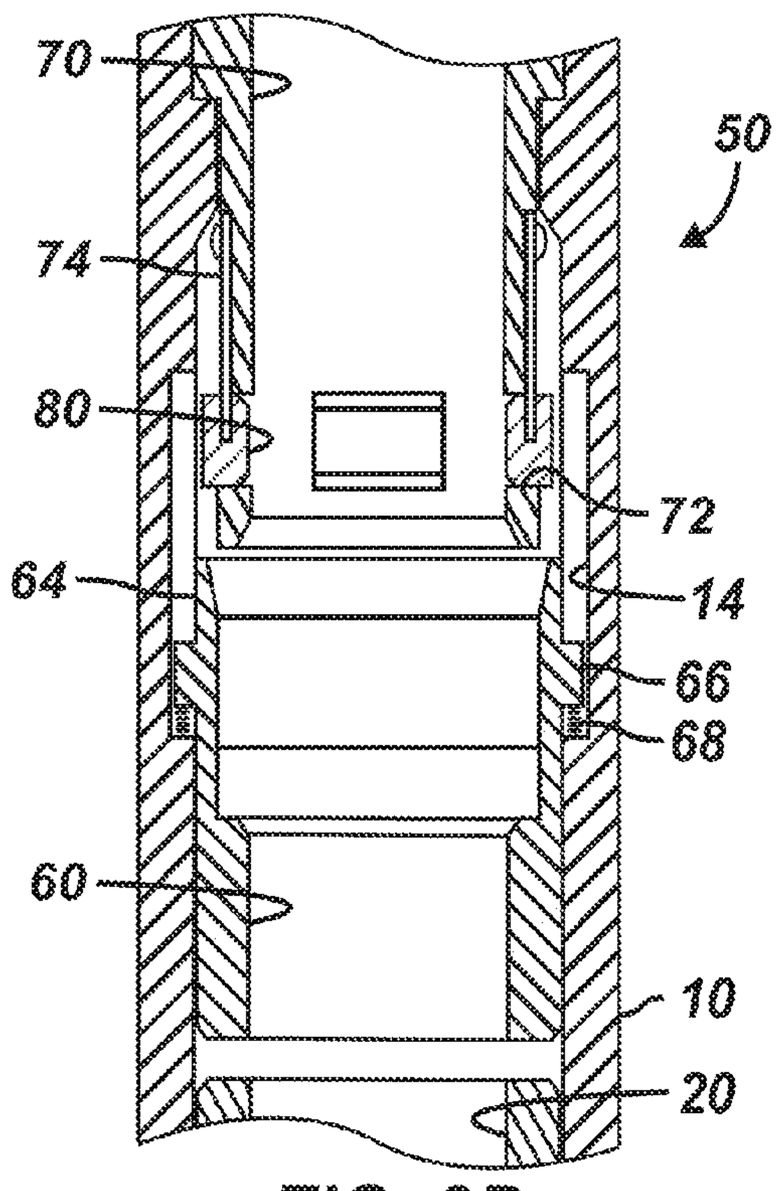


FIG. 3D

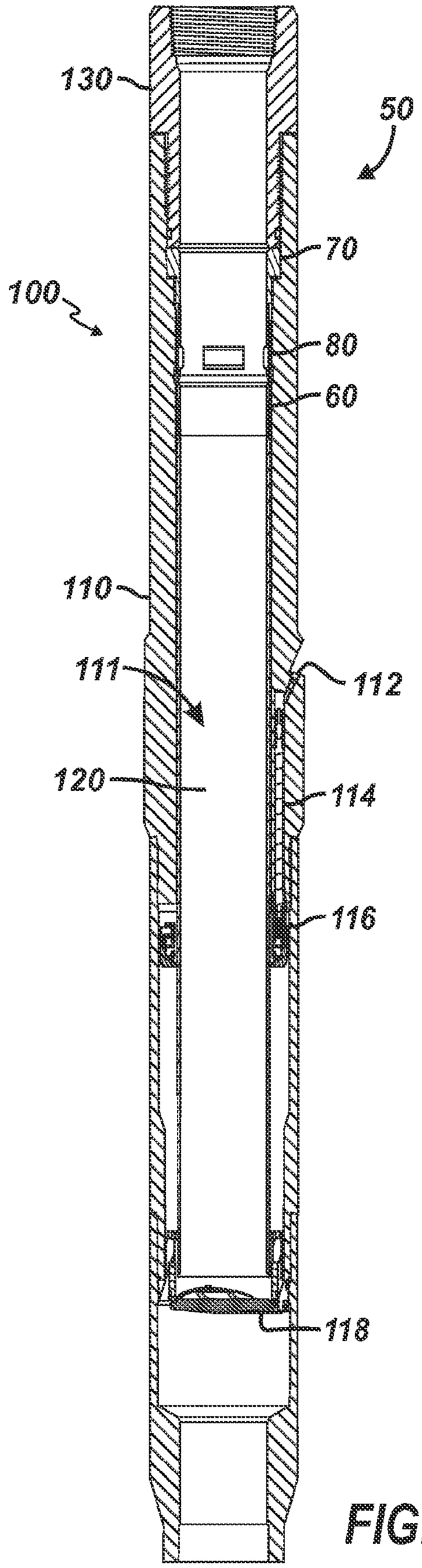
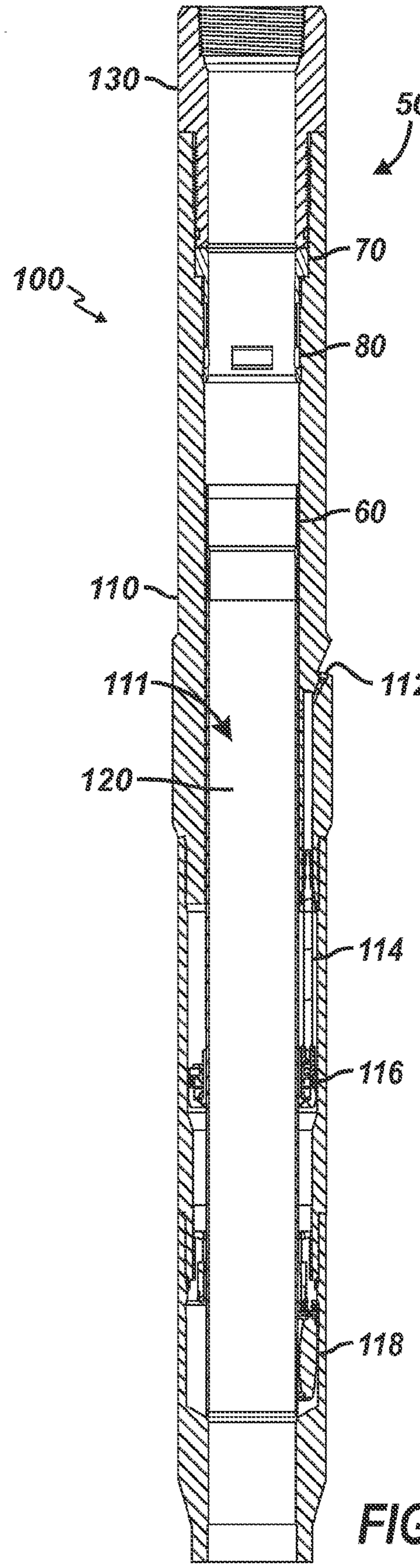

130
50
70
100
80
60
110
111
112
120
114
116
118

FIG. 4A


130
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120
114
116
118

FIG. 4B

PASSABLE NO-GO DEVICE FOR DOWNHOLE VALVE

BACKGROUND

Flapper valves and other types of downhole valves can be damaged if a tool string is allowed to pass through them when they are in the closed condition. For example, the tool string run through the valve can damage the valve's flapper when closed. Also, the tool string even if capable of passing through the closed flapper may not be allowed to pass back up through the flapper so that the tool sting becomes trapped by the valve.

From the surface, operators do not always know if the flapper in these type of valves is open or not. Typically, operators must run a wireline drift tool through the valve to determine if the flapper is open or closed. If the flapper is open, then the drift tool is able to pass through. If the flapper is closed, the drift tool will stick through the flapper which then activates an artificial hold open sleeve to allow for the drift tool to be retrieved. Another way operators can determine whether a flapper is open or closed involves running a camera downhole and feeding back images to the surface.

Sometimes, a downhole valve may have dogs that engage a specifically designed stringer used to open and close the valve. For example, Weatherford's completion isolation valve (CIV) is a ball type valve actuated by a stinger. Dogs in the CIV engage the stinger and allow the stinger to move internal components to open and close the valve's ball seal. In this instance, these dogs move with the internal components of the valve that operate the ball seal. Therefore, these dogs are directly used to operate the valve by engaging the stinger and not to passively prevent a generic type of tool from being passed through the valve when closed.

What is needed is a way to reliably and easily prevent potential damage to a downhole valve by a generic tool string and to prevent entrapment of the tool string in the valve by passively preventing mechanical passage of the tool string in the valve when closed.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1**A illustrates a passable no-go device for a downhole flow control tool in a no-go condition.

FIG. **1**B illustrates the passable no-go device in the no-go condition preventing a tool string from passing into the downhole flow control tool.

FIG. **2**A illustrates the passable no-go device in a passable condition.

FIG. **2**B illustrates the passable no-go device in the passable condition allowing a tool string to pass into the downhole flow control tool.

FIGS. **3**A-**3**B show an alternative arrangement between the tool's flow tube and the passable no-go device.

FIGS. **3**C-**3**D show another alternative arrangement between the tool's flow tube and the passable no-go device.

FIG. **4**A illustrates the passable no-go device in the no-go condition used on a hydraulically actuated flapper valve when closed.

FIG. **4**B illustrates the passable no-go device in the passable condition used on the hydraulically actuated flapper valve when opened.

DETAILED DESCRIPTION

A passable no-go device **50** illustrated in FIG. **1**A is used with a downhole flow control tool having a housing **10** and an actuator **20**. The flow control tool can be a downhole valve,

and the actuator **20** can a flow tube hydraulically actuated between first and second positions to control fluid flow through the housing **10** by actuating a flapper (not shown) in the tool. The device **50** includes an activation member **60**, a support **70**, and dogs **80**. The support **70** fits into the housing's flow passage **12**, and an end piece **30** fits on the end of the housing **10** and holds the support **70** therein. The support **70** has windows **72** that hold the dogs **80** therein. The dogs **80** are movable into and out of the windows **72** relative to the housing's flow passage **12**, and springs **74** connect the dogs **80** to the support **70** and bias the dogs **80** to a retracted position in the windows **72**.

As shown in FIG. **1**A, the activation member **60** attaches to a distal end of the actuator **20** (e.g., flow tube) by threads **62**, although other forms of affixing the member **60** to the flow tube **20** can be used. The member **60** has a distal lip **64** that is passable in a space behind the dogs **80** to force the dogs **80** to a no-go condition through the windows **72**. In this no-go condition as shown, the dogs **80** extend partially into the housing's flow passage **12**. To prevent the dogs **80** from passing completely through the windows **72**, the dogs **80** can have ledges or shoulders (not shown) along their back edges that engage sides of the windows **72**. Preferably, the lip **64** has a smaller inner diameter to fit in the space behind the support **70**. Also, the support **70** preferably has the same diameter bore as the tool's flow passage **12** so that as little flow restriction occurs as possible.

As shown in FIG. **1**B, the extended dogs **80** inhibit or restrict a tool string T attempting to pass through the device **50** in the housing's flow passage **12** while the lip **64** on the flow tube **20** forces the dogs **80** into their no-go condition. As discussed below, this no-go condition may occur when the flow tube **20** is moved into a first (uppermost) position in the tool's housing **10**, for example, when a hydraulically activated flapper valve is closed.

As shown in FIG. **2**A, the passable no-go device **50** has a passable condition when the activation member **60** on the flow tube **20** is moved away from the support **70**. In this condition, the lip **64** is removed from the space around the support **70**, and the springs **74** bias the dogs **80** out of the support's windows **72**. Therefore, the dogs **80** are allowed to move into the free space around the support **70**. In this passable condition, a tool string T is mechanically uninhibited or unrestricted by the dogs **80** as the tool string T passes through the tool's housing **10** as shown in FIG. **2**B. As discussed below, this passable condition may occur when the flow tube **20** is moved into a second (lower) position in the tool's housing **10**, for example, when a hydraulically activated flapper valve is opened.

In addition to preventing a tool string T from passing through a closed flow control tool, the passable no-go device **50** may advantageously prevent (full) closure of the downhole flow control tool when the tool string T is positioned through the opened tool. When the tool is open as shown in FIG. **2**B with the tool string T passing through, the retracted dogs **80** positioned in the space around the support **70** can stop the upward movement of the flow tube **20** by engaging the lip **64**. Even though the lip **64** is made to fit behind and push the dogs **80** and may have a beveled edge, the dogs **80** may be prevented from extending through the windows **72** by engaging the profile of the tool string T passing through the flow passage **12**. In this way, the lip **64** and flow tube **20** are not allowed to reach their uppermost position because the dogs **80** cannot extend. This can prevent full closure of the flow control tool and can prevent some forms of damage to the tool.

Although the activation member **60** is shown as a separate component from the flow tube **20** in FIGS. **1**A through **2**B, the

features of the lip **64** can be integrally formed with the flow tube **20**. As shown in FIGS. **3**A-**3**B, for example, the lip **64** can be integrally formed on the end of the flow tube **20** and can operate in the same way discussed above to move behind and away from the space around the support to move the dogs **80**. In another alternative shown in FIGS. **3**C-**3**D, the lip **64** can be part of an independent activation member **60** unattached to the flow tube **20**. In this way, abutting engagement of the flow tube **20** with the activation member **60** can move the lip **64** in the space behind the support **70**. In this arrangement, the member **60** may have ridges **66** or the like that are held within slots **14** defined in the housing's flow passage **12** to guide the member's movement. In addition, the member **60** may be biased away from the support **70** by one or more springs **68** (shown here as extension springs) when the flow tube **20** is moved away from the member **60**.

The passable no-go device **50** can be used with any downhole flow control tool that controls fluid flow therethrough but must also allow tool strings to pass through the tool when opened. Some suitable downhole flow control tools for use with the passable no-go device **50** include safety valves, downhole control valves, downhole deployment valves, fluid loss valves, and the like.

As shown in FIGS. **4**A-**4**B, for example, the passable no-go device **50** is shown used with a hydraulically actuated flapper valve **100**. In this example, the valve **100** has a housing **110** with a flow passage **111**. In the valve **100**, a flow tube **120** in the flow passage **111** acts as an actuator and is hydraulically actuated between first and second conditions. A flapper **118** acts as a closure member for the flow passage **110** and is mechanically operated between opened and closed conditions by the flow tube **120**.

In operation, the absence of hydraulic pressure at a hydraulic port **112** allows the flapper **118** to pivot closed and restrict fluid flow through the valve **100** as shown in FIG. **4**A. When hydraulic pressure is applied as shown in FIG. **4**B, the hydraulic control fluid communicated through the port **112** actuates a piston **114** connected to the flow tube **120** by a coupling **116**. The hydraulically actuated piston **114** thereby moves the flow tube **120** downward in the housing **110** to open the flapper **118** and permit fluid flow through the valve **100**. A spring (not shown) may be provided in the space around the flow tube **120** to bias the flow tube **120** to its uppermost position so that the flapper **118** is biased closed.

When the flapper **118** is closed as shown in FIG. **4**A, it is preferred that a tool string is not allowed to pass through the valve **100** because the tool string could damage the closed flapper **118**. Even if a tool string were allowed to pass the closed flapper **118**, operators may not be able to back out the tool string because the flapper **118** may catch on portions of the tool string preventing its retrieval from the valve. To overcome these problems, the passable no-go device **50** installed as part of the flapper valve **100** passively reacts to the opened or closed condition of the valve **100** to either permit or restrict mechanical passage of a tool string through the valve **100**.

To do this, the passable no-go device **50** prevents the tool string from reaching the flapper **118** when closed by tying its operation to the independent operation of the flapper valve **100**, which is hydraulically actuated by separate means. In other words, the passable no-go device **50** acts as a restricting member mechanically operated by the flow tube **120** and responds to the closing of the flapper **118** by the upward moving flow tube **120** so that the dogs **80** extend and prevent mechanical passage of the tool string through the valve **100**. As shown in FIG. **4**A, the flapper **118** is closed because the flow tube **120** is moved to its uppermost position in the housing **100**. The activation member **60** moved by the flow tube **120** fits behind the support **70** and pushes the dogs **80** into the valve's flow passage **111**. In this restrictive no-go condition, the device **50** at least partially restricts mechanical passage through the flow passage **111** because the dogs **80** can mechanically restrict a tool string from getting to the flapper **118** while closed.

On the other hand, the passable no-go device **50** responds to the opening of the flapper **118** by the downward movement of the flow tube **120** when the valve **100** is opened so that the dogs **80** retract and allow mechanical passage of the tool string through the valve **100**. As shown in FIG. **4**B, the flapper **118** is opened because the flow tube **120** has been hydraulically moved to its lowermost position in the housing **100**. The activation member **60** on the upper end of the flow tube **120** is moved away from the support **70** and allows the dogs **80** to retract from the valve's passage **111**. In this unrestrictive passable condition, the dogs **80** will not restrict a tool string from passing through the valve **100**, removes the mechanical restriction through the valve **100**.

As will be appreciated, the passable no-go device **50** eliminates the need for an initial discovery run with a camera or a drift tool to be performed to determine if the flapper **118** is first open before running a tool string through the flapper valve **100**. Instead, the tool string can be run down hole. If the valve **100** is inadvertently left closed or is inoperable for some reason, then the passable no-go device **50** can prevent further passage of the tool string to the valve **100**. This can speed up running in and out of the wellbore and can reliably reduce the potential of damage to the flapper **118** or a stuck tool string.

The foregoing description of preferred and other embodiments is not intended to limit or restrict the scope or applicability of the inventive concepts conceived of by the Applicants. In exchange for disclosing the inventive concepts contained herein, the Applicants desire all patent rights afforded by the appended claims. Therefore, it is intended that the appended claims include all modifications and alterations to the full extent that they come within the scope of the following claims or the equivalents thereof.

What is claimed is:

1. A downhole flow control tool, comprising:

a housing having a flow passage;

an actuator movably disposed in the housing and being actuatatable between first and second conditions;

a closure member movably disposed in the flow passage and operated by the actuator, the closure member having a closed condition at least partially restricting fluid flow through the flow passage in response to the actuator having the first condition, the closure member having an opened condition removing the flow restriction in response to the actuator having the second condition; and

a restricting member axially fixed in the flow passage, at least a portion of the restricting member being laterally movable in the flow passage and being passively operated by the actuator, the restricting member having a restrictive condition at least partially restricting mechanical passage through the flow passage in response to the actuator having the first condition, the restricting member having an unrestrictive condition removing the mechanical restriction in response to the actuator having the second condition.

2. The tool of claim **1**, wherein the downhole flow control tool comprises a downhole valve.

3. The tool of claim **2**, wherein the closure member comprises a flapper rotatably connected to the housing.

4. The tool of claim 1, wherein the restricting member comprises one or more dogs movable between extended and retracted positions in response to the movement of the actuator, the one or more dogs in the extended position at least partially restricting the flow passage, the one or more dogs in the retracted position removing the restriction.

5. The tool of claim 4, wherein the restricting member comprises a support disposed in the flow passage and having one or more windows, the support supporting the one or more dogs movably disposed in the one or more windows.

6. The tool of claim 5, wherein an activation member movable by the actuator is positionable between the support and the housing, whereby the activation member positioned between the support and the housing extends the one or more dogs through the windows and at least partially into the flow passage, and whereby the activation member positioned away from the support permits the one or more dogs to retract in the one or more windows.

7. The tool of claim 6, wherein the activation member comprises a lip integrally formed on the actuator.

8. The tool of claim 6, wherein the activation member comprises a lip affixed to and movable with the actuator.

9. The tool of claim 6, wherein the activation member comprises a lip independent of the actuator and movable by engagement with the actuator.

10. The tool of claim 5, wherein one or more springs bias the one or more dogs to the retracted position.

11. A downhole valve, comprising:

a housing having a flow passage;

a flow tube movably disposed in the flow passage and being hydraulically movable between first and second positions;

a closure member movably disposed in the flow passage and mechanically operated by the flow tube, the closure member having a closed condition at least partially restricting fluid flow through the flow passage in response to the flow tube having the first position, the closure member having an opened condition removing the flow restriction in response to the flow tube having the second position; and

one or more dogs axially fixed in the flow passage, the one or more dogs being laterally movable in the flow passage and passively operated by the flow tube, the one or more dogs having an extended position at least partially restricting mechanical passage through the flow passage in response to the flow tube having the first position, the one or more dogs having a retracted position removing the mechanical restriction in response to the flow tube having the second position.

12. The valve of claim 11, wherein the closure member comprises a flapper rotatably connected to the housing.

13. The valve of claim 11, wherein the housing comprises a support disposed in the flow passage and having one or more windows, the support supporting the one or more dogs movably disposed in the one or more windows.

14. The valve of claim 13, wherein a member movable by the flow tube is positionable between the support and the housing, whereby the member positioned between the support and the housing extends the one or more dogs through the windows and at least partially into the flow passage, and whereby the member positioned away from the support permits the one or more dogs to retract in the one or more windows.

15. The valve of claim 14, wherein the member comprises a lip integrally formed on the flow tube.

16. The valve of claim 14, wherein the member comprises a lip affixed to and movable with the flow tube.

17. The valve of claim 14, wherein the member comprises a lip independent of the flow tube and movable by engagement with the flow tube.

18. The valve of claim 11, wherein one or more springs bias the one or more dogs to the retracted position.

19. A passable no-go apparatus for a downhole flow control tool, comprising:

a support axially fixable in a flow passage of a downhole flow control tool, the support defining a space between an outer surface of the support and the flow passage, the support defining one or more windows communicating the space with an interior passage through the support; and

one or more dogs disposable in the one or more windows of the support, the one or more dogs being laterally movable between extended and retracted positions in the one or more windows of the support, the one or more dogs in the extended position extending at least partially into the interior passage of the support, and one or more dogs in the retracted position retracted from the interior passage,

wherein the one or more dogs are movable by passive interaction with a portion of the downhole flow control tool that is independently movable in the space between the support and the flow passage.

20. A downhole apparatus, comprising:

a housing having a flow passage;

means for hydraulically actuating between first and second mechanical conditions;

means for at least partially restricting fluid flow through the flow passage in response to the first mechanical condition and for permitting fluid flow through the flow passage in response to the second mechanical condition;

means fixed axially in the flow passage for at least partially restricting mechanical passage through the flow passage passively in response to the first mechanical condition and for permitting mechanical passage through the flow passage passively in response to the second mechanical condition.

* * * * *